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Case Report
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Troubleshooting; Split Lung Block for an *Ex Vivo* Perfusion

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Abbreviations

RLL: Right Lower Lobe; LTx: Lung Transplant; DBD: Brain-Dead Donor; cDCD: Controlled Donation after Circulatory Death; uDCD: Uncontrolled Donation after Circulatory Death; EVLP: *Ex-Vivo* Lung Perfusion; N-EVLP: Non *Ex-Vivo* Lung Perfusion; PGD: Primary Graft Dysfunction; MV: Mechanical Ventilation; ICU: Intensive Care Unit; ECMO: Extracorporeal Membrane Oxygenation; PEEP: Positive End Expiratory Pressure; ONT: National Transplant Organization (Spanish abbreviation); PA: Pulmonary Artery; PVR: Pulmonary Vascular Resistance; CIT: Cold Ischemia Time; Cdyn: Dynamic Compliance

Central Picture

Organ in the LS-1 organ chamber during perfusion prior to ventilation, and after table surgery adjustment (Figure 1).

Introduction

Lung transplantation is the curative treatment for patients who have end-stage lung disease. However, unlike other solid organs such as kidneys and liver, only 15% to 25% of lungs from donors are transplanted [1]. Therefore, *Ex Vivo* Lung Perfusion (EVLP) has become an essential tool to expand the number of lung donors in recent years.

Case Presentation

A 52-year-old male with a past medical history of depression and atrial fibrillation was offered as a potential Maastricht III donor. The patient had a P/F of 320 mmHg, normal bronchoscopy, and condensation on the Right Lower Lobe (RLL) on the X-ray and CT scan (Figure 2A, 2B). Grafts were accepted for in situ evaluation. During the assessment, asystole was confirmed 45 min after withdrawal with a warm ischemic time of 30 min. After flushing and macroscopic inspection of the grafts, modest bilateral edema was discovered along with RLL atelectasis. Therefore, an *Ex Vivo* Evaluation (EVLP) was considered for a reconditioning and further evaluation of the organs. Miscommunication between the harvesting and implanting teams resulted in separate storage and transport of the. Nevertheless, EVLP evaluation was approved, and the organs were brought to

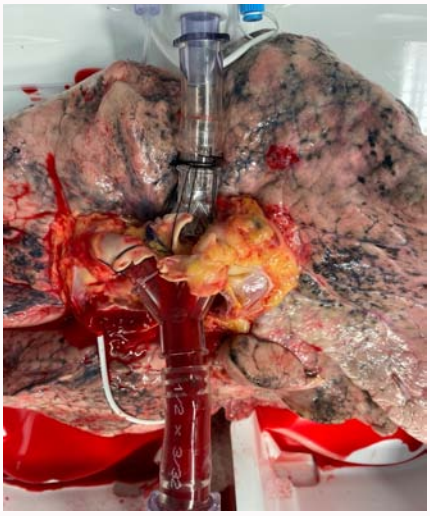

Figure 1: Organ in the LS-1 organ chamber during perfusion prior to ventilation, and after table surgery adjustment.

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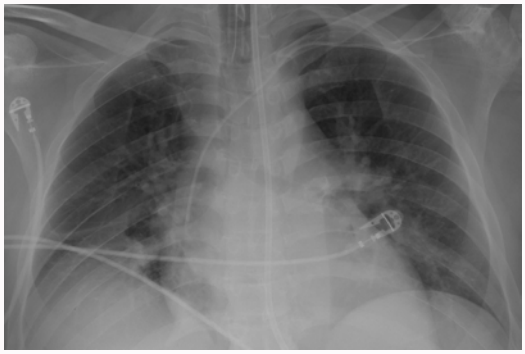

Figure 2A: Donor's X-ray. Showing right lower lobe atelectasis.

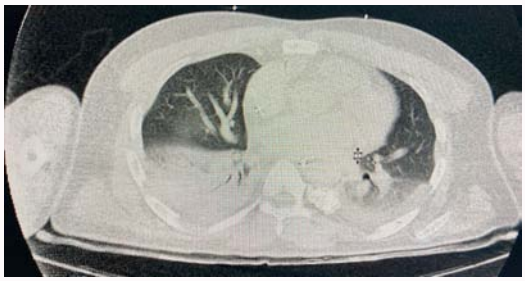

Figure 2B: Donor´s CT scan. Showing right lower lobe atelectasis.

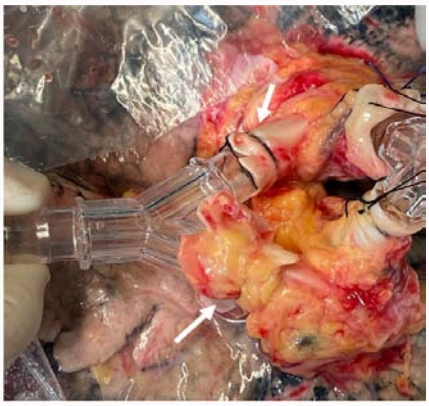

Figure 3: Y connector in the pulmonary artery with silk tight around each individual partially dissected branch (arrows).

the perfusion lab where additional table surgery was required. A 1/2, 3/8-inch "y" connector with a piece of priming hues on the 1/2 end and a silk ligature around each dissected pulmonary artery was used to adapt the circulatory circuit (Figure 3). The same was done for the airway, a pace of hues with ventilator adapter in a 1/2 end of the y connector. While a silk ligature around the 3/8 end of the connector and the left main bronchus was enough to fitting and secure it (Figure 4), an extra maneuver was required due to a size discrepancy of the main right bronchus. The short remaining trachea was split, and a supplementary pace of hues was placed over the 3/8 end to adapt the gauge (Figure 4). Thus, securing it with a tie was possible and final reassembly of the airway was accomplished. Extra silk sutures on the edge of the bronchus were placed and tied on the 1/2 end to prevent displacement during ventilation (Figure 5). After table surgery the organs were placed in the perfusion chamber (Figure 6) and modified *ex-vivo* Lund protocol was followed. During 90 min of perfusion, the lungs showed steady PA pressure, PVR, proper

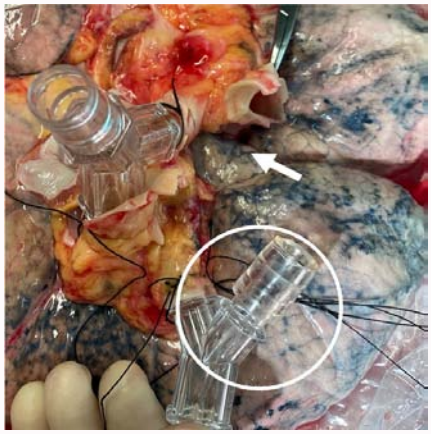

Figure 4: Y connector one end on the left main bronchus with silk tight. Circulated; A hues pace on the other end to adapt sizes. Arrow in the trachea divided and ready for the adapted end.

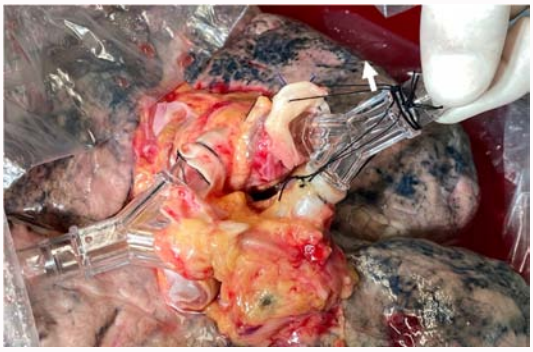

Figure 5: Y connectors in place and additional silk stitches (arrows) on the edge of the bronchus and tied to the proximal end to prevent disengage.

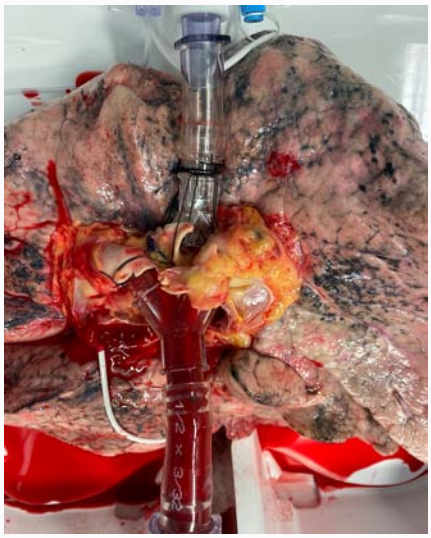

Figure 6: Organ in the LS-1 organ chamber during perfusion prior to ventilation.

flow, substantial improvement of the atelectasis and edema, and compliance and reduction in peak pressure. PO2 after the evaluation was >450 mmHg. The lungs were accepted for transplant, then flushed and cold preserved to be implanted in a 64-year-old female with severe pulmonary fibrosis requiring a bilateral lobar transplant.

Unfortunately, a problematic postoperative due to multiple complications, starting with a severe pulmonary graft dysfunction requiring postoperative ECMO overlapped with severe pancreatitis, followed by an untreatable hemolytic uremic syndrome, leads to a multiorgan failure and death 55 days after the transplant.

Discussion

Lung transplantation is an accepted modality of care for patients with end-stage lung diseases. However, as dedicated centers grapple with an ever-growing waiting list, graft shortage, approximately 10% to 13% of lung transplant candidates die waiting every year [2]. Lung utilization rate is 15% to 20% from eligible multiorgan donors [3], the lowest of solid organs. Some alternatives such as marginal donors [4], lobar transplantation [5], living-related donors, Donation after Circulatory Death (DCD) donors, have been introduced to overcome this shortage. In addition, *ex vivo* lung perfusion is safe and effective alternative to solve donor shortage in lung transplantation.

Ex Vivo Lung Perfusion (EVLP) is an alternative to conventional approaches for donor lung assessment, reconditioning, and preservation in clinical lung transplantation. Allowing re-evaluation of questionable donor lungs before implantation and seizing the opportunity to repair injured donor lungs that are otherwise unsuitable for transplantation.

In our experience, EVLP has positively impacted our program, increasing the overall transplant activity by 14% from perfused organs with an additional 5% from lung donors assessed with EVLP intentions that are transplanted immediately. However, EVLP requires several technical considerations, such as long stems of PA and trachea for table surgery and organ emplacement. This case represents a typical challenge during clinical EVLP and a successful way to evaluate and yield a lung donor.

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